Federal Aviation Administration

Terminal Flight Data Manager

Operational Functional Description

Terminal Planning (AJT-3)

and

Terminal Program Operations (AJT-1)

DRAFT

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1. Introduction

The Terminal Flight Data Manager (TFDM) program is a key ground infrastructure program for NextGen. TFDM will provide an integrated tower data automation system which will improve tower controllers' common situational awareness in order to support the NextGen Concept of Operations.

TFDM provides several enhancements for tower personnel. The TFDM automation system:

- Integrates flight data with terminal area and surface surveillance data, where available, including associated alerts and alarms indicating potentially unsafe conditions on the surface or between arriving and departing aircraft.
- Electronically processes and distributes flight data to different control positions in the tower.
- Provides a suite of Decision Support Tools (DSTs) that assist air traffic controllers in performing their tasks for more efficient and safe airport operations.
- Consolidates disparate legacy tower systems into an open, scalable architecture. Consolidation and replacement of legacy platforms, input devices, and displays will mitigate limited tower cab space and equipment end-of-life issues.
- Provides a platform for flight data exchange across domains and enhance collaborative tactical decision making for airport surface operations.
- Publishes data to internal and external National Airspace System (NAS) stakeholders
- Subscribes to data from internal and external NAS stakeholders

Use of common data will make TFDM a highly integrated tower automation system. The electronic processing and distribution of flight data will vastly enhance data exchange between the en route, terminal, and Traffic Flow Management (TFM) domains; Airline Operations Centers (AOCs); and Airport Operators. The DSTs will provide tower controllers with the first major automated decision support tools beyond those provided by Airport Surface Detection Equipment-Model X (ASDE-X).

2. Scope and Purpose

The purpose of this document is to define the specific operational capabilities for each TFDM work package planned for inclusion in the program's Initial Investment Decision in 2012. The intent is to describe the capabilities TFDM will provide without detailing specific solutions for providing those capabilities. The work package capabilities identified in this document will support NextGen mid-term operations in the areas of flight planning; push back, taxi and departure; and arrival and landing as the primary contributor to the NextGen mid-term Operational Improvement (OI) 104209: Initial Surface Traffic Management. It is anticipated that additional work packages will be needed to support NextGen far-term operations. Work packages for the far-term operations are not identified in this document.

TFDM capabilities will be implemented in incremental work packages. The assignment of capabilities to specific work packages is based on inputs from Air Traffic and engineering subject matter experts and on-going modeling and prototyping efforts. As the engineering and modeling/prototyping efforts continue, this document will be updated to reflect any changes to the distribution of capabilities between the work packages.

3. Work Package Capabilities

The capabilities that TFDM will provide controllers are categorized into five main groups:

- Flight Data
- Surveillance Data
- Traffic Management
- Tower Management
- Aeronautical and Weather Data
- Decision Support Tools

These capabilities will be configurable for use by: Ground Control (GC), Local Control (LC), Assistant Local, Clearance Delivery (CD), Flight Data (FD), Front Line Manager (FLM), Traffic Management Coordinator (TMC), Ground Metering, Monitor and Control System Administration.

To provide these capabilities, data exchange with external sources (NAS and non-NAS) will be required.

This high-level view of TFDM capabilities, data exchange, and tower positions is provided in Figure 1.

The first work package, referred to in this document as "TFDM Core," will be the foundation upon which additional capabilities will be added. It is projected that TFDM will require multiple work packages to deploy all planned TFDM capabilities identified in this document.

The following sections identify the functions planned for TFDM Core and follow-on work packages.

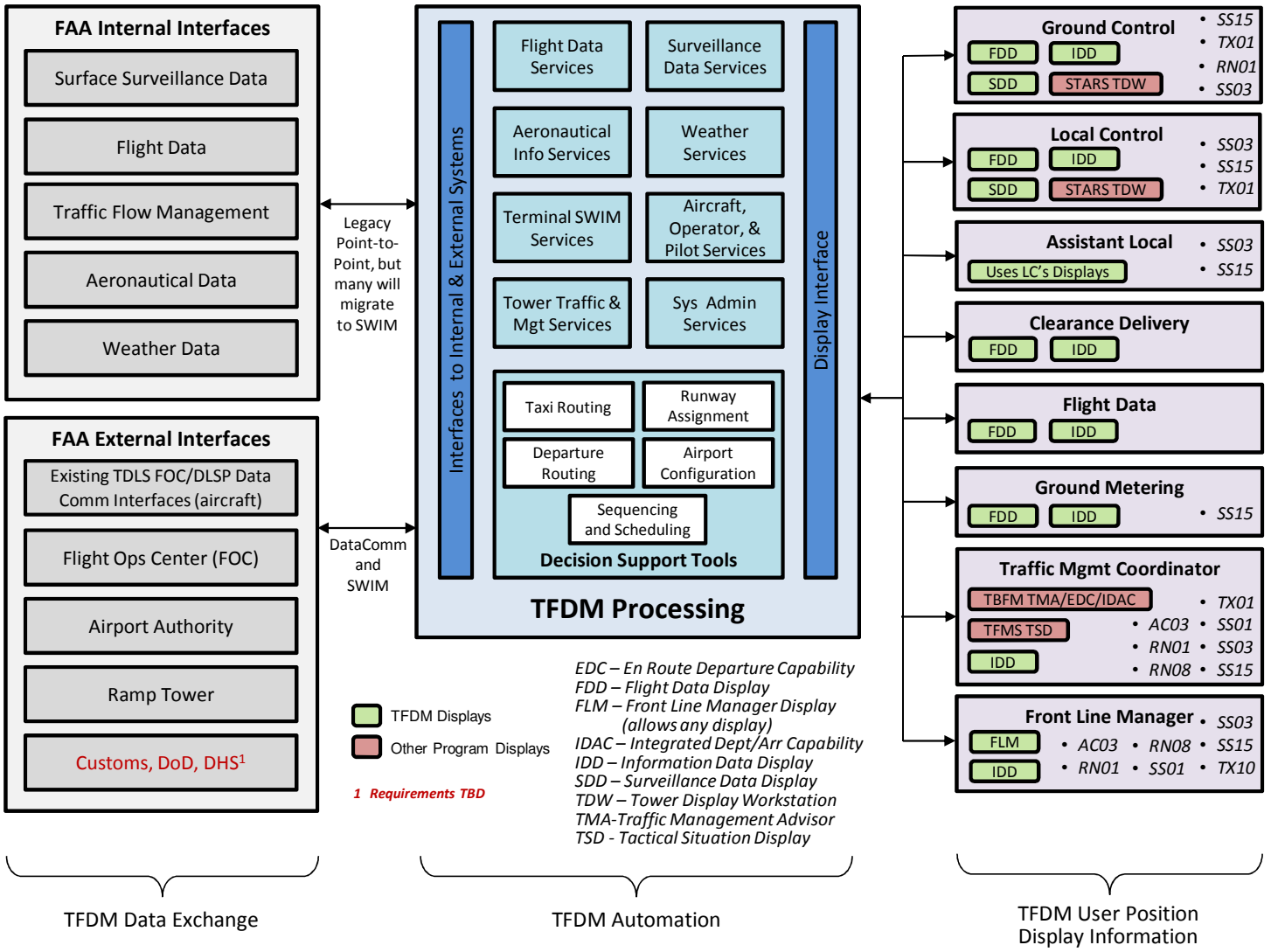

Figure 1 – TFDM Schematic

3.1 TFDM Core

As the foundation for TFDM, Core will consist of software and hardware that will provide capabilities in each of the five areas: flight data, surveillance data, traffic management, tower management, aeronautical and weather information, and decision support tools. This "core" TFDM system will:

- Replace the paper flight strip system used in many Air Traffic Control Tower (ATCT) cabs with an electronic flight data system that is integrated with surveillance data, where available.
- Provide tower management, aeronautical information, and tower DataComm functions.
- Provide foundational DST capabilities for Airport Configuration (AC), Runway Assignment (RN), Sequencing and Scheduling (SS), and Taxi Routing (TX).
- Provide automated exchange of information with many internal Federal Aviation Administration (FAA) systems and limited external FAA systems

The capabilities described in the following sections will establish the TFDM Core baseline. This baseline will be tailored by site depending upon factors, such as availability of surface surveillance data, existing systems, tower activity levels, complexity of operations, and number of positions.

3.1.1 Flight Data Capabilities

TFDM Core will include the following flight data capabilities:

- Receive new flight plans
- Create new flight plans (visual flight rules [VFR]/instrument flight rules [IFR])
- Send and receive electronic flight data (flight plans, amendments to flight plans, Traffic Management Initiatives (TMI) and flight specific movements) within the tower and to the TRACON
- Provide notification of changes to the electronic flight data
- Provide tower data link departure clearance messages
- Provide both visual and aural alerts in the event that a controller tries to apply instructions or flight data updates that contradict a rule or the runway and taxiway status configuration
- Publish flight events to NAS subscribers that began in the System Wide Interface Management (SWIM) Terminal Data Distribution System (STDDS) program, including taxi start and takeoff

The flight data will be available via displays and input devices that will allow tower controllers to manipulate the data. Prompts will be provided for changes to flight data. Controllers will be able to amend multiple electronic flight data items all at one time. System interaction will allow a controller to assign runways, queue locations and provide flight plan markings that will act on either one or many sets of flight data for aircraft controlled by a specific tower position. Controllers will be able to recall timed out electronic flight data from an archive state for research or re-file. Templates for flight plan entry or amendments to flight plans will be available to improve flight plan entry.

Controllers will have the ability to sort and search by multiple categories of data. For example, when using flight specific times to sort, system settings will be able to provide sort results showing data from most accurate to least accurate. And, when sorting by departure time, the sort order could be TMI followed by Proposed Departure Time (PDT). Core also provides a filter capability. Certain electronic flight data contained within flight plans will be searchable. This will allow a search for particular aircraft identification, those assigned to a particular runway, or any other field in the electronic flight data.

Electronic arrival information will provide an interactive way to track traffic. The information will provide aircraft identification with “cleared to land” and “hold short” markings.

Alarms, alerts, and prompts will be used to indicate actions upon which the controller will need to intervene. Alarms will be triggered by runway incursions, line up and wait on closed runway, or line up and wait on a runway that does not match assignment. Alarms will highlight the electronic flight data and have an aural signal with a required acknowledgement. Alerts are a lower priority than alarms but will also alert the controller to intervene. Alerts are also used to notify the controller of environmental changes that will affect all flights, such as Low Level Wind Shear Alert System (LLWAS) alerts. Prompts will highlight non safety items through the use of the electronic flight data. The electronic flight data field will change due to a change in Automated Terminal Information Service (ATIS), TMI, flight plan change, expiring flight plan, Expected Departure Clearance Time (EDCT) timer, or runway or taxiway change due to airport configuration change.

Alerts will be provided for TMI and inactive flight plans about to expire. Information alerts will provide messages pertinent to specific operations, such as Call For Release (CFR) and TMI.

TMI constraints can be entered into the system and flights that are affected by a constraint will be indicated. Input of constraints will affect the status of a flight in the schedule timeline at the FLM/TMC position.

At locations with surface surveillance, the surface surveillance data and flight data will be integrated and will assist controllers with locating aircraft and tracking aircraft movement.

The TFDM system will archive and playback flight data per FAA Order requirements.

The system will publish surface flight events, including surface and/or local traffic pattern events. This will allow NAS participants to more finely manage their operations, especially important for events which potentially disrupt operations such as go-arounds and missed approaches.

The TFDM software which provides flight data capabilities will be configurable for each facility and for each controller position including GC, LC, CD, FD, Ground Metering, and FLM/TMC. The system will provide each position with identical capabilities, but the flight data will be configured differently. Configurable items will include:

- Flight data layout
- Runway and taxiway layout
- Taxi routes
- Airport configurations changes
- Runway and taxiway closures

The LC flight data presentation will have a configuration and labeling that map to the airport’s configuration. The data presentation will reconfigure to match an airport configuration change once the change has been accepted.

The GC flight data presentation will have configuration specific layout and an interface for easy assignment of runways and queuing locations.

During periods of reduced operations and staffing, positions can be combined to provide a consolidated workstation with the functionality of multiple positions in one. Screens will be reconfigurable for lighting and environmental conditions. Stations will allow the storage of controller preference sets for different operating conditions and different operators.

3.1.2 Surveillance Data Capabilities

TFDM Core will include the following surveillance data capabilities:

- Surface Surveillance and Flight Data Information Integration: Surveillance recognition of aircraft ready for taxi will introduce the aircraft's corresponding electronic flight strip to controller. Aircraft selected on surveillance data presentation will highlight corresponding electronic flight information on flight data presentation.
- Target Icon Presentation: Provide icons to represent traffic through color, size and shape. Aircraft will be identifiable by category and weight group (small, medium, large, heavy), and icons will differentiate aircraft, vehicle, and helicopters.
- Safety Features: Provide closed runway and hold bar indicators and wake vortex countdown timer. Provide additional information and alerts, such as LLWAS information and LLWAS alerts.
- Additional Features: Display terminal airspace with the ability to segment and zoom in on a specific area. Other display elements that will be available include a wake timer and airport configuration designator.
- Data Exchange: Publish surveillance data to NAS subscribers that began in the SWIM STDDS program, including ASDE-X event and position data.

The surveillance data will be accessible via displays and input devices that will allow tower controllers to view and manipulate the surveillance data.

Display of surveillance data will include display of airport map information, including but not limited to: entry points, ramps, gates, taxiways, de-ice pads, holding areas, run-up pads, and runways. The user will be able to configure the airport map to include aircraft information with a data tag displaying information such as aircraft type, position, heading, speed, altitude, weight category, runway assignment, and first departure fix.

Integration of flight data and surveillance data will assist controllers with their operations. The system will recognize outbound aircraft approaching the airport movement area and automatically change the display to show the aircraft in a pre-taxi state, making it easier for the controller to manage.

The TFDM software which provides surveillance data capabilities will be enabled at facilities with surface surveillance and configurable for display at any controller position including GC, LC, Ground Metering, and FLM/TMC.

3.1.3 Traffic Management Capabilities

TFDM provides traffic management capabilities to air traffic control personnel to support the movement of traffic on the airport surface.

- Manage Runway Assignment Rules: Runway assignment rules are based on criteria such as flight data and configuration data. The rules are based on local procedures and nominal values created in adaptation. These nominal rules can be modified and saved dynamically. Runways will be assigned based on local adaptation of fix to runway, departure route, gate location, and load balancing rules. Queuing locations will be assignable both manually and automatically.
- Display and Manipulate Arrival Departure Timelines: Arrival and departure timelines are derived from information provided by TFDM and other NAS systems to provide an estimated departure and arrival sequence and schedule per runway. Timelines also depict runway demand and have the ability to display flight specific constraint and flight plan information. The timelines can be manipulated to provide a what if look at proposed changes to the airport configuration or ATC procedures, e.g. runway assignment rules.

- Input TMI Constraint Times: The TMI manual entry menu provides a list of fixes, airways, radar sectors that can be selected and scheduled as constraints. Entries would revise timelines, electronic flight data and provide notice to controllers
- Provide Receipt of Flight Data Notifications: The TMC position will display time-outs of EDCTs, ASDE-X conflict alerts, etc.
- Flight Plan Locator: Tower personnel will have the ability to search for flight plans, both current and historical. This will provide the tower a means to review past operational data or recall flight plans for re file.
- Exchange Traffic Management Data: The traffic management capabilities subscribe to TFMS and TBFM constraint and schedule information, as well as publish local traffic management data to TFMS. The goal is a more direct, timely, and expanded data exchange with TFMS and TBFM to reduce verbal coordination and optimize traffic flow throughout the NAS.

3.1.4 Tower Management Capabilities

TFDM provides tower management capabilities to air traffic control (ATC) personnel to support the management of tower operations and to coordinate those operations with other systems and/or users internal and external to the NAS

TFDM Core will include the following tower management capabilities:

- Manage the Airport Configuration: Airport configurations are defined in site adaptation and can be selected or scheduled in TFDM by tower personnel. Changes to a runway and/or taxiway status can also be input and all changes will provide a notification to tower personnel.
- Provide Electronic Checklist: There will be an airport configuration change checklists for use when an airport configuration change is made and all position will have standard electronic position relief checklists. The data will be saved and archived per FAA rules.
- Manage Runway Assignments: Runways assignments rules can be changed to accommodate offloading or unusual operations.
- Provide Alarm, Alert and Prompt Enable/Inhibit Menu: The FLM position will be allowed to set some alarms/alerts. Controller positions will also allow the controller to set alarms/alerts and prompts, including aural and visual alarms and acknowledgements. The controller can also acknowledge/silence these alarms, alerts, and prompts. These capabilities will be consistent with FAA orders and policies.

3.1.5 Aeronautical and Weather Data Capabilities

TFDM Core will include the following aeronautical and weather data capabilities:

- Display of Aeronautical Information: For example: NOTAM, charts, maps, approach plates, procedures, time, Letters of Agreement (LOAs), Standard Operating Procedures (SOPs)
- Display and Alerting of Weather Information: For example: altimeter, wind, weather observations, runway visibility, wind shear, microburst, gust front predictions
- Manual Input and Display of Local Tower Information: For example: local weather observations, airport conditions, local NOTAM
- Provide Aeronautical and Weather Data to NAS stakeholders: For example: military, airline operations centers, pilots

TFDM will format the data and the information will be configurable for display at any position. TFDM aeronautical and weather information will be tailored by site according to the systems available at a site. TFDM will store and archive the data as appropriate. Controllers will be able to conduct searches on the data and retrieve stored and archived data in accordance with FAA policy.

3.1.6 Decision Support Tools Capabilities

TFDM Core will provide capabilities for four of five DST categories:

- Airport Configuration (AC)
- Runway Assignment (RN)
- Scheduling and Sequencing (SS)
- Taxi Routing (TX)

The specific core capabilities are:

- Analyze, Implement and Disseminate Airport Configuration Change – AC03-TC
- Assign departure runway based on pre-defined rules – RN01-TC
- Provide real-time runway assignment rule management and use – RN08-TC
- Generate runway Schedule – SS01-TC
- Display flight specific TFM times/constraints and indicators – SS03 -TC
- Generate flight state data – SS15-TC
- Manage and display real-time state of runways and taxiways – TX10-TC
- Provide queue location and/or intersection departure – TX01-TC

Analyze, Implement and Disseminate Airport Configuration Change (AC03-TC)

This functionality provides a limited, manual, "what-if" planning to assess the queuing/ congestion impact of a single proposed configuration change at specified time. Automation considers forecast traffic and runway loading. Runway closures can be manually entered. Airport configuration planning is not only the physical layout, but includes runway use, resource availability (including runways and taxiways and their segments), and Standard Operating Procedures (SOPs).

Results are displayed to facilitate discussion among decision-makers and stakeholders.

The automation provides functionality to implement/schedule an airport configuration and configuration change. The last arrival and last departure of current configuration can be manually entered and displayed. The first arrival and first departure for a new configuration can also be entered and displayed.

A TFMS or SWIM interface will be used to disseminate airport configuration change information, as these interfaces become available.

The automation relies on the SS01-T1C surface modeling and planning functionality.

Assign departure runway based on pre-defined rules (RN01-TC)

Rule set considerations include factors such as airline, gate, departure fix, destination, aircraft type. This capability generates a runway assignment, based on the rules. Runway assignment is based on airport configuration expected to be active at departure time (as calculated by SS01).

Runway assignment is displayed and can be changed by controller with control responsibility for the flight.

When the airport configuration changes or any of the considered factors change, automation updates the runway assignment for flights in the non-movement area. For flights in the Airport Movement Area (AMA), there is a prompt to the controller.

Provide real-time runway assignment rule management and use (RN08-TC)

This function provides dynamic management of new rules for the automation to use for runway assignment. Runway assignment rule management includes creation, addition, modification, selection, de-selection, deletion, and override of runway assignment rules.

RN03 allows the management of rules and use of the rules and any changes for runway assignment. For Core, the factors for the rule creation are the same as RN01. New runway assignment rules can be created, e.g., cases of runway/taxiway closure, Temporary Flight Restriction (TFR), nearby convective weather.

Real-time runway assignment rules in effect can be displayed.

Generate Runway Schedule (SS01-TC)

This is a foundational function, showing both runway demand and predicted schedule, using as much information as available, including both arrivals and departures. The Core implementation, at a minimum, uses airline schedule (e.g., Aggregate Demand List [ADL]), proposed and updated departure times, TFM constraint data, departure runway from surface automation, and ASDE-X surveillance data when available. Arrival runway data will be used as available. This function provides the surface planning and modeling automation.

The capability will incorporate TFM constraints/times available electronically to TFDM, such as EDCTs via En Route Automation Modernization (ERAM) and departure times from TBFM. Manual input and update of TFM constraints/times by FLM/TMC/Controller-in-Charge (CIC), GC, LC and CD are allowed.

Schedules adjust based on changes to runway status, airport configuration changes, runway assignments, rule changes, and flight data updates. Data updates revise the schedule as appropriate.

Display flight specific TFM constraint times and indicators (SS03-TC)

This capability incorporates TFM times/constraints and updates from SS01, to ensure visibility of TFM times/constraints to controllers. The indicator may be a reminder, highlight, or prompt that the constrained time is approaching or that the constrained time has been missed.

In Core, the indicator is not predictive.

Display to the controller is likely on an electronic flight data display.

Generate flight state data (SS15-TC)

This function generates and updates flight state data and associated times, e.g. flight in taxi to runway, flight in taxi to de-ice pad, flight in line-up and wait state.

Manage and display real-time state of runways and taxiways (TX10-TC)

This functionality displays current situational awareness information, e.g., a closed taxiway segment due to a disabled aircraft; includes capability for controller entry. The display includes both entire taxiways and runways as well as taxiway and runway segments.

The functionality provides for manual input to close and re-open taxiways, runways and their segments.

Taxiway and runway status are provided on the surveillance data and flight data displays.

Provide queue location and/or intersection departure (TX01-TC)

Automation presents the set of pre-defined queue locations and/or intersection departures applicable to a departure runway and the planned airport configuration at the expected departure time. The controller selects the appropriate queue location and or intersection departure, if any.

3.1.7 Data Exchange

To provide the flight data capabilities, surface surveillance and tower management capabilities, data exchange with the following systems will be required:

- En Route Automation
    - En Route Automation Modernization (ERAM): TFDM will receive filed flight plan data from the FAA's En Route Automation system (currently provided by FDIO). TFDM will send flight plan data that has been amended or created at the tower to the en route automation system.
- Traffic Management
    - Traffic Flow Management System (TFMS): TFDM will receive scheduled flight plan data from TFMS in order to include anticipated flights in the TFDM departure timelines at the FLM/TMC position.
    - Time Based Flow Management (TBFM): TFDM receives TMIs, arrival/departure demand from TBFM. TFDM sends recommended and assigned flight departure runway and time, flight state and airport configuration to TBFM.
- Data Communication
    - Data Link Services: TFDM will subsume the TDLS Tower components (legacy applications and display) or alternately integrate a vendor supplied solution. TFDM will interface to the legacy TDLS remote infrastructure known as the TDLS Information Management System (TIMS). TIMS connects the Tower component of TDLS via the NAS Enterprise Security Gateway (NESG) to the Communications Service Providers (CSPs), which in turn send flight data (DPC, DCL, D-ATIS) from TDLS to the aircraft and their respective FOCs and exchange logon/logoff data to ERAM. TFDM will also receive acknowledgement and text messages from airline operations and aircraft.
    - Flight Operations Centers; TFDM will receive flight status (Call sign, gate and estimated off block time) from the airline FOCs. TFDM will send departure and arrival runway (recommended and assigned) and time of departure (estimated and actual) to the FOC.
- Terminal Automation
    - TRACON Automation: Elimination of EFSTS in the Tower results in TFDM sending flight data (taxi and departure) to the EFSTS server in the TRACON. TFDM will also send last in, first out and time of change for airport reconfiguration. TRACON will send flight arrival information from STARS to TFDM.
- SWIM Services
    - TFDM subsumes STDDS and publishes data previously published by STDDS, including RVR and ASDE-X data, plus data entered by controllers into TFDM and generated by controllers through DSTs.
    - TFDM additionally could use SWIM to exchange data with TFMS, TBFM, FOCs, Ramp Toers, Airport Authorities and Remote Monitoring and Logging Systems (RMLS).

  - TFDM will use SWIM to consume information from the following SWIM Implementation Programs (SIPs):
    - Corridor Integrated Weather System (CIWS)
    - Integrated Terminal Weather System (ITWS)
    - AIM [including information extracted from the Airport Geographical Information Systems (AGIS)

- Adaptation Information
  - AIM: TFDM receives NOTAMS, SUA, TFR, aeronautical (airport geographic and airspace) and static airport configuration data from AIM. TFDM sends airport configuration changes (scheduled and actual).
- Surface Surveillance
  - ASDE-X, Airport Surface Surveillance Capability (ASSC), and Low Cost Ground Surveillance (LCGS): TFDM will receive track data and safety logic alarms and alerts from the surface surveillance system.
- Automation Systems:
  - NAS Information Display System (NIDS)
  - Federal NOTAM System (FNS)
  - Digital Audio Legal Recording System (DALRS) for GPS Coded Time Source (clock)
- TFDM subsumes NAS Information Display System (NIDS) and ACE-IDS and will interface to their respectective data sensors/sources, including on or more of the following:
  - Automated Weather Sensor System (AWSS)
  - Automated Surface Observing System (ASOS)
  - Weather Observing System (AWOS)
  - Digital Altimeter Setting Indicator (DASI)
  - Wind Measuring Equipment (WME)
  - Low Level Wind Shear Alert System (LLWAS)
  - Terminal Doppler Weather Radar (TDWR)
  - Stand-Alone Weather Sensors (SAWS)
  - Corridor Integrated Weather System (CIWS)
  - Integrated Terminal Weather System (ITWS)
  - Runway Visual Range (RVR)
  - Runway Visibility Value (RVV)

3.1.8 System Replacement

Depending upon which TFDM alternative solution is approved for implementation and end-of-life (supportability) of legacy equipment, all or part of the following flight data systems and equipment may be replaced with the deployment of TFDM Core:

- Flight Data
    - Flight Data Input/Output (FDIO)
    - Tower Data Link System (TDLS)
    - Advanced Electronic Flight Strip System (AEFSS)
    - Electronic Flight Strip Transfer System (EFSTS)
    - Flight Strip Bays and Drop Tubes

Depending upon which TFDM alternative solution is approved for implementation and end-of-life (supportability) of legacy equipment, the display, user data entry, and display processing equipment for the following surveillance data systems may be replaced with the deployment of TFDM Core:

- Airport Surface Detection Equipment-Model X (ASDE-X)
- Airport Surface Surveillance Capability (ASSC)
- Low Cost Ground Surveillance (LCGS)

Depending upon which TFDM alternative solution is approved for implementation and end-of-life (supportability) of legacy equipment, all or part of the tower management data systems and equipment may be replaced with the deployment of TFDM Core:

- Airport Resource Management Tool (ARMT)

Depending upon which TFDM alternative solution is approved for implementation and end-of-life (supportability) of legacy equipment, the displays in the tower cab for the automation and weather systems listed above will be consolidated with the deployment of TFDM Core. Other legacy systems, for which TFDM will replace all or part of the system equipment, such as displays, processors, etc., include:

- Automated Surface Observation System Controller Equipment Integrated Display System (ACE-IDS)
- Tower Data Link System (TDLS) with Digital Automated Terminal Information System (D-ATIS)
- Ribbon Display Terminal (RBDT)

3.2 TFDM Future Work Packages

Future work packages will build on the functionality of TFDM by improving on the following capabilities:

- Flight Data Capabilities
- Surveillance Data Capabilities
- Tower Management Capabilities
- Aeronautical and Weather Information Capabilities
- DSTs

3.2.1 Flight Data Capabilities

Future work packages will provide additional flight data capabilities. Future work packages provide taxi conformance violation notifications, which affect flight data capabilities. Flight data capabilities will also support future work package DSTs. Active flight plans will be prevented from timing out with automatic proposed departure time updates. The system may publish surface flight events such as surface or local

traffic pattern events. Additionally, alerts can be provided for line up and wait with traffic on final (distance configurable).

To provide the flight data capabilities, data exchange with the following systems will be required (this is in addition to the interfaces required for core):

- Airline Operators/SWIM to receive departure prediction and departure status information from flight operators

No additional flight data system consolidation is anticipated for future work packages.

3.2.2 Surveillance Data Capabilities

TFDM future work packages will extend the surveillance data capability to display gate assignments on aircraft tags and to indicate gate conflicts.

TFDM future work packages will provide taxi conformance violation notifications, which will affect the surveillance data capability. Additionally, TFDM future work packages will enhance the surveillance data capability to display taxi route assignments during this period.

No additional data exchange is anticipated for surveillance data capabilities for future work packages.

No additional surveillance data system consolidation is anticipated for future work packages.

3.2.3 Tower Management Capabilities

TFDM future work packages will extend tower management capabilities to allow system taxi routes and queuing locations to be assignable both manually and automatically for monitoring where available and for display.

To provide the tower management capabilities, data exchange with the following systems will be required (this is in addition to the interfaces required for core):

- Time Based Flow Management (TBFM) data for arrival/departure integration
- AOCs to implement Surface Collaborative Decision Making for departures
- Additional data exchange for arrival departure traffic management

Depending upon which TFDM alternative solution is approved for implementation and end-of-life (supportability) of legacy equipment, all or part of the following tower management systems and equipment may be replaced with the deployment of future work packages:

- Airport Resource Management Tool (ARMT)
- Surface Management Advisor (SMA)
- Time Based Flow Management (TBFM)

3.2.4 Aeronautical and Weather Data Capabilities

TFDM future work packages will extend aeronautical and weather data capabilities to include integration of weather data constraints into DSTs.

TFDM will publish and/or subscribe to additional aeronautical and weather information SWIM services, including:

- Aeronautical Common Services (ACS)
- NextGen Weather Processor (NWP)

No additional aeronautical and weather data system consolidation is anticipated for future work packages.

3.2.5 Decision Support Tools Capabilities

The TFDM future work packages will provide additional capabilities for all five DST categories:

- Airport Configuration (AC)
- Departure Routing (DR)
- Runway Assignment (RN)
- Scheduling and Sequencing (SS)
- Taxi Routing (TX)

The specific capabilities are:

- Recommend configuration change and time – AC01-T1
- Display flight specific departure route indicator – DR01-T1
- Analyze manually entered runway assignment – RN02-T1
- Balance departure loads on runways – RN03-T1
- Process flight specific departure runway assignment information from flight operators – RN07-T1
- Integrate Wake Turbulence Mitigation for Departures into Runway Assignment – RN11-T1
- Recommend departure runway sequence – SS02-T1
- Estimate flight specific surface event times – SS05-T1
- Process flight specific information from Flight Operators/Ramp Towers – SS11-T1
- Monitor surface schedule compliance – SS13-T1
- Process de-icing information and surface schedule impacts – SS16-T1
- Manage Departure Queue collaboratively with Flight Operators – SS17-T1
- Manage the Surface Departure Schedule Collaboratively with Flight Operators – SS18-T1
- Integrate Wake Turbulence Mitigation for Departures into the Surface Schedule – SS22-T1
- Analyze alternatives for surface management – SS24-T1
- Manually assign pre-defined taxi route to a flight – TX01-T2
- Manually enter and Assign ad hoc taxi route to a flight – TX02-T2
- Recommend pre-defined two-dimensional taxi route – TX03-T2
- Recommend non-standard two-dimensional taxi route – TX04-T2
- Monitor conformance to two-dimensional taxi route – TX11-T2
- Monitor aircraft compliance with control instructions – TX12-T2

Recommend configuration change and time (AC01-T1)

When there is a demand/capacity imbalance, this capability advises an airport configuration change by indicating the configuration and time of transition. Modeling more fully considers factors such as weather, wind, time of operations (e.g., night operations) and noise control. Interface/adaptation

considerations: Uses pre-defined airport configurations; needs airport specific rule-set for conditions/thresholds for configuration change.

Display flight specific departure route indicator (DR01-T1)

This capability is a display in the tower indicating the results of the evaluation performed by the TFM departure route assessment. The display indicates to all tower positions: 1) that the flight's departure route is blocked and when to expect a re-route. The display to the FLM/CIC/TMC also includes weather or traffic flow constraints likely to impact a filed departure route.

Analyze manually entered runway assignment (RN02-T1)

This functionality provides what-if analysis for a manually-entered runway assignment. The what-if results show the change in the departure schedule and any flight specific delays..

Balance departure loads on runways (RN03-T1)

When adapted for use, this functionality supports balancing departure loads on runways when a capacity/demand imbalance is predicted (SS01). This functionality works in coordination with SS01 (Generate runway schedule) and RN01 (Assign departure runway).

Process flight-specific departure runway assignment information from flight operators (RN07-T1)

Flight operator can provide and update flight-specific operationally acceptable runways and departure intersections. Flight operators can provide and update ordered runway preferences. Automation will consider flight operator provided information to assign runways. The flight specific operationally acceptable runways, departure intersections and ordered runway preferences can be available to display to the tower controller.

Integrate Wake Turbulence Mitigation for Departures into Runway Assignment (RN11-T1)

This functionality integrates WTMD information into runway assignments. WTMD status (enabled or off) is transmitted to the runway assignment automation. When FLM/CIC enables WTMD, the runway assignment automation takes into account WTMD information to assign runways. When WTMD status is off, it is no longer used to assign runways. When the WTMD status changes from enabled to off, the status change does not result in any runway assignment changes by the automation to flights in the AMA.

Recommend departure runway sequence (SS02-T1)

This capability supports the automated generation of sequencing recommendations for a runway.

Automation generates a sequence recommendation (e.g., recommended order of flights for efficient throughput) based on flight data, and sequencing rules (adapted for the airport) such as splitting departure fixes, TFM constraints, controlled departure times, wake turbulence spacing requirements, and initial departure separation requirements. Automation also takes into account flight-operator provided information such as flight priorities or departure intersection capabilities.

Generate flight-specific surface event times (SS05-T1)

This functionality generates flight-specific times from surface automation modeling for event times/windows, such as off-block time, movement area entry time, and departure time, to meet the planned surface schedule (SS01), to be in compliance with any TFM controlled departure times, and to include criticality of the constraint/schedule. Surface event times are updated as the surface model (SS01) is updated.

Process Flight-specific Information from Flight Operators/Ram Towers (SS11-T1)

This function receives data from the flight operators/ramp tower and uses that data in generating the surface schedule (SS01). The detailed data from flight operators/ramp towers includes data such as

parking location, off-block time, flight priorities, gate conflicts, and aircraft de-icing information. The data include estimates, updates, and actuals.

Monitor surface schedule compliance (SS13-T1)

This capability is closely related to SS03, which addresses TFM constraints/times. The capability relates to the surface schedule when metering with SS18 and/or to the off-block times and times at the spot for flights with TFM constraints/times. The functionality can both detect and predict non-compliance with the flight departure time, time at the spot, and off block time.

This capability displays a notification to the controller and shares predicted and actual non-compliance data with the flight operator/ramp tower.

Process de-icing information and surface schedule impacts (SS16-T1)

This capability processes flight specific de-icing information from flight operators (see SS11), airport configuration information for de-icing, and predicted and actual de-icing queues. The functionality provides icing impacts and timing information to SS01 to be reflected in the surface schedule. Flight specific de-icing information is displayed.

Manage Departure Queue Collaboratively with Flight Operators (SS17-T1)

This function provides automation to Manage Departure Queue Wait Time through an aggregate allocation of a number of flights that can enter the movement area to individual flight operators during a specific time interval conducted on a runway by runway basis and/or metering category basis. A metering category is a resource that is capacity constrained, such as a departure fix and/or runway. The goal is for equitable distribution of delay among all flight operators within metering categories.

The flight operator response indicates the use of its allocation, which is displayed in the tower. Flight operators will be responsible for movement area entry at times that ensure flights depart within applicable controlled departure time windows.

Manage the Surface Departure Schedule Collaboratively with Flight Operators (SS18-T1)

This function provides automation to manage the departure surface schedule by generating flight-specific movement area entry times in metering categories that consider all applicable constraints, such as EDCTs. Automation provides the flight operator flight-specific movement area entry times. The flight operator has flexibility to reallocate flights within the same metering category to one of the flight operator's movement area entry time slots. The flight operator sends the results of any reallocation, e.g., flights and associated timeslots, which update the surface schedule. Flight operators will be responsible for movement area entry at times that ensure flights depart within applicable controlled departure time windows. The flight specific movement area entry times are displayed to the tower.

Integrate Wake Turbulence Mitigation for Departures into the Surface Schedule (SS22-T1)

Wake turbulence mitigation for departures (WTMD) is integrated into the surface schedule (SS01). When the runway is enabled, automation updates departure times based on WTMD times. When WTMD is turned off, departure times are updated to non WTMD departure procedures.

Analyze alternatives for surface management (SS24-T1)

This functionality notifies the FLM/CIC/TMC when there will be a problem with surface capacity based on demand. The automation supports what-if analysis and shows the capacity/demand comparison of applying and/or combining different alternatives such as airport configuration change, changing runway-fix mapping, runway balancing, CDQM/CDS, sequencing for throughput improvement, while satisfying TFM constraints. FLM/CIC/TMC provides inputs for alternatives that require parameters, such as airport configuration or runway fix mapping.

Manually assign pre-defined taxi route to a flight (TX01-T2)

This functionality provides for manual assignment of pre-defined taxi routes to individual flights by tower personnel. Automation presents the set of pre-defined taxi routes, based on the flight's characteristics, surface location and destination and airport configuration. Automation takes into account closed taxiways or taxiway segments. An airport configuration change may result in and display an indicator for a taxi route update.

This capability is foundational to support surface conformance monitoring. This capability does not support aircraft-aircraft de-confliction.

The controller can modify a pre-defined taxi route. The controller assigns a taxi route to the flight manually and issues the clearance.

Manually enter and assign ad hoc taxi route to a flight (TX02-T2)

This capability provides for manual entry and assignment of ad hoc taxi routes by tower personnel who consider the flight's characteristics, surface location and destination and airport configuration. Automation assistance can facilitate taxi route entry by providing for example, taxi segments and acceptable alternatives or route completion. An ad hoc route can be a manual modification to a pre-defined route. The automation verifies the acceptability of the ad hoc route with respect to open and closed taxiways and taxiway segments, hold shorts for crossing the runway, and taxiway use rules, e.g., direction of taxi. An airport configuration change may result in and display an indicator for a taxi route update.

The controller assigns a taxi route to the flight manually and issues the clearance.

The functionality provides for entering the taxi route once and using it once or entering and re-using the taxi route.

Recommend pre-defined two-dimensional taxi route (TX03-T2)

This capability provides automated recommendation of a pre-defined two-dimensional taxi route for a flight, without time dimension. The recommended pre-defined route includes hold shorts when the taxi route crosses a runway and other hold shorts (e.g., a taxi intersection used as a sequencing merge point).

The capability does not consider aircraft-aircraft deconfliction. The controller may select another predefined taxi route (TX01-T2), may enter an ad hoc taxi route (TX02), or can modify the pre-defined route. An airport configuration change may result in and display an indicator for a taxi route update.

Recommend non-standard two-dimensional taxi route (TX04-T2)

This capability provides automated recommendation of a non-standard (i.e., not pre-defined) two-dimensional taxi route for a flight, without time dimension, from its surface location to its surface destination. When the route crosses a runway, a hold-short is inserted in the route. The capability does not consider aircraft-aircraft deconfliction. The controller can modify the recommended non-standard route, select a predefined taxi route (TX01-T2) or may enter an ad hoc taxi route (TX02). The automation takes into account open and closed taxiways and taxiway segments, hold shorts for crossing a runway, and taxiway use rules, e.g., direction of taxi. An airport configuration change may result in and display an indicator for a taxi route update.

Monitor conformance to two-dimensional taxi route (TX11-T2)

This functionality supports monitoring conformance to a flight's two-dimensional taxi route. Automation monitors aircraft position with respect to the known taxi route and notifies the controller if the aircraft deviates from the lateral taxi route. The alerting notification is based on non-conformance severity.

Monitor aircraft compliance with control instructions (TX12-T2)

This functionality supports monitoring aircraft compliance with known control instructions such as hold short, line up and wait, and cleared for takeoff and notifies the controller when automation detects aircraft deviation from the control instruction. The alerting notification is based on non-conformance severity.

To provide these DST capabilities, data exchange with the following systems will be required (this is in addition to the interfaces required for core):

- Airline Operations Centers (AOCs)
- Airport Ramp Operations

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6. Abbreviations and Acronyms

Acronym	Stands for
AC	Airport Configuration
ACE-IDS	Automated Surface Observation System Controller Equipment Integrated Display System
ACS	Aeronautical Common Services
ADL	Aggregate Demand List
AEFSS	Advanced Electronic Flight Strip System
AGIS	Airport Geographical Information Systems
AIM	Aeronautical Information Management system
AJT	FAA Air Traffic Organization, Terminal Services
AMA	Aircraft Movement Area
AOCs	Airline Operations Centers
ARMT	Airport Resource Management Tool
ASDE-X	Airport Surface Detection Equipment
ASOS	Automated Surface Observation System
ASSC	Airport Surface Surveillance Capability
ATC	Air Traffic Control
ATCT	Air Traffic Control Tower
ATIS	Automatic Terminal Information Service
AWOS	Automated Weather Observation System
AWSS	Automated Weather Sensor System
CAASD	MITRE Center for Advanced Aviation Systems Development
CD	Clearance Delivery
CDQM	Collaborative Departure Queue Management
CDS	Collaborative Departure Scheduling
CFR	Call For Release
CIC	Controller-in-Charge
CIWS	Corridor Integrated Weather System
CSP	Communications Service Providers
DALRS	Digital Audio Legal Recording System
DASI	Digital Altimeter Setting Indicator
DCL	Departure Clearance
DR	Departure Routing
DST	Decision Support Tools
EDCT	Estimated Departure Clearance Time
ERAM	En Route Automation Modernization
FAA	Federal Aviation Administration
FD	Flight Data
FDIO	Flight Data Input/Output

Acronym	Stands for
FLM	Front Line Manager
FNS	Federal NOTAM System
FOC	Flight Operations Center
GC	Ground Control
GPS	Global Positioning Satellite
Host	NAS En Route Stage A
IFR	Instrument Flight Rules
ITWS	Integrated Terminal Weather System
LC	Local Control
LCGS	Low Cost Ground Surveillance
LLWAS	Low Level Wind Shear Alert System
LOAs	Letters of Agreement
MINIT	Minutes In Trail
MIT	Miles in Trail
NAS	National Airspace System
NESG	NAS Enterprise Security Gateway
NIDS	NAS Information Display System
NOTAMS	Notices to Airmen System
NWP	NextGen Weather Processor
OI	Operational Improvement
PDC	Pre Departure Clearance
PDT	Proposed Departure Time
RBDT	Ribbon Display Terminal
RMLS	Remote Monitoring and Logging Systems
RN	Runway Assignment
RVR	Runway Visual Range
RVV	Runway Visibility Value
SAWS	Stand Alone Weather System
SMA	Surface Management Advisor
SOPs	Standard Operating Procedures
SS	Sequencing and Scheduling
STARS	Standard Terminal Automation Replacement System
STBO	Surface Trajectory-Based Operations
STDDS	SWIM Terminal Data Distribution System
SUA	Special Use Airspace
SWIM	System Wide Interface Management
TBFM	Time Based Flow Management
TDLS	Tower Data Link System
TDWR	Terminal Doppler Weather Radar

Acronym	Stands for
TFDM	Terminal Flight Data Manager
TFM	Traffic Flow Management
TFMS	Traffic Flow Management System
TFR	Temporary Flight Restriction
TIMS	TDLS Information Management System
TMC	Traffic Manager
TMI	Traffic Management Initiatives
TMS	Traffic Management Services
TRACON	Terminal Radar Approach Control
TX	Taxi Routing
VFR	Visual Flight Rules
WARP	Weather and Radar Processor
WME	Wind Measuring Equipment
WTMD	Wake Turbulence Mitigation for Departures